Figure 1

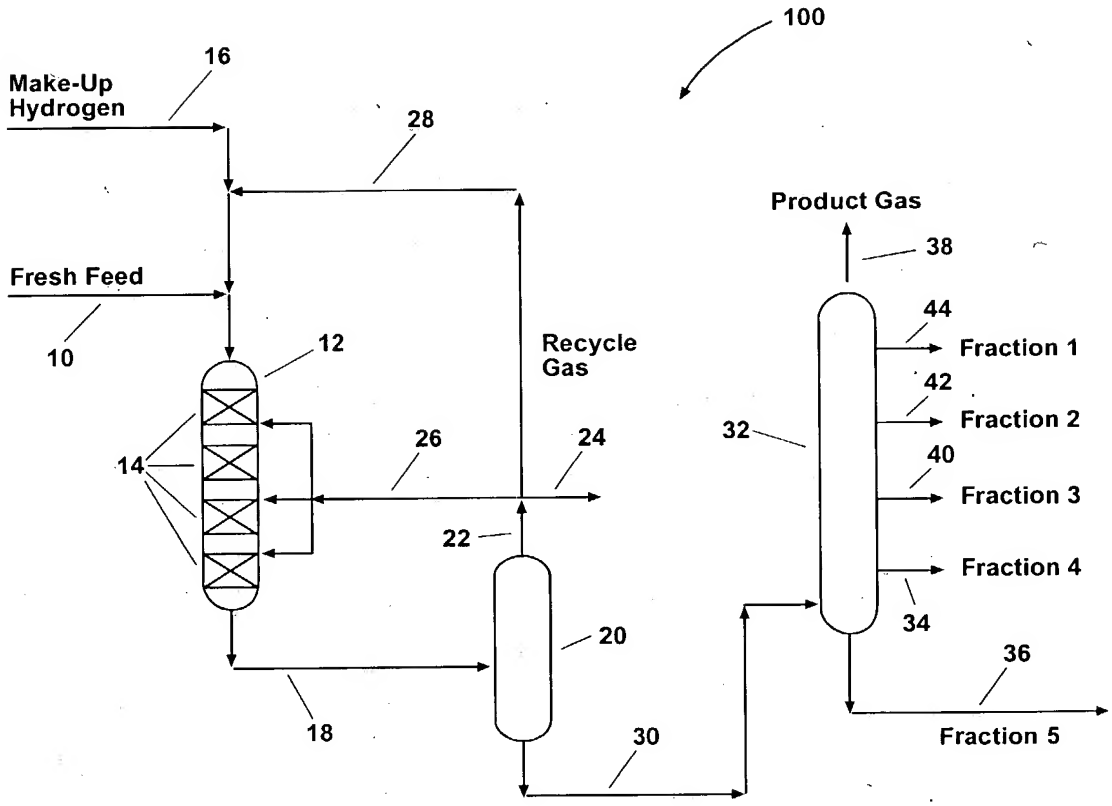

100
16
Make-Up Hydrogen
28
Fresh Feed
10
12
Recycle Gas
14
26
24
22
20
18
30
Product Gas
38
44
Fraction 1
42
Fraction 2
32
40
Fraction 3
Fraction 4
34
36
Fraction 5

Figure 2

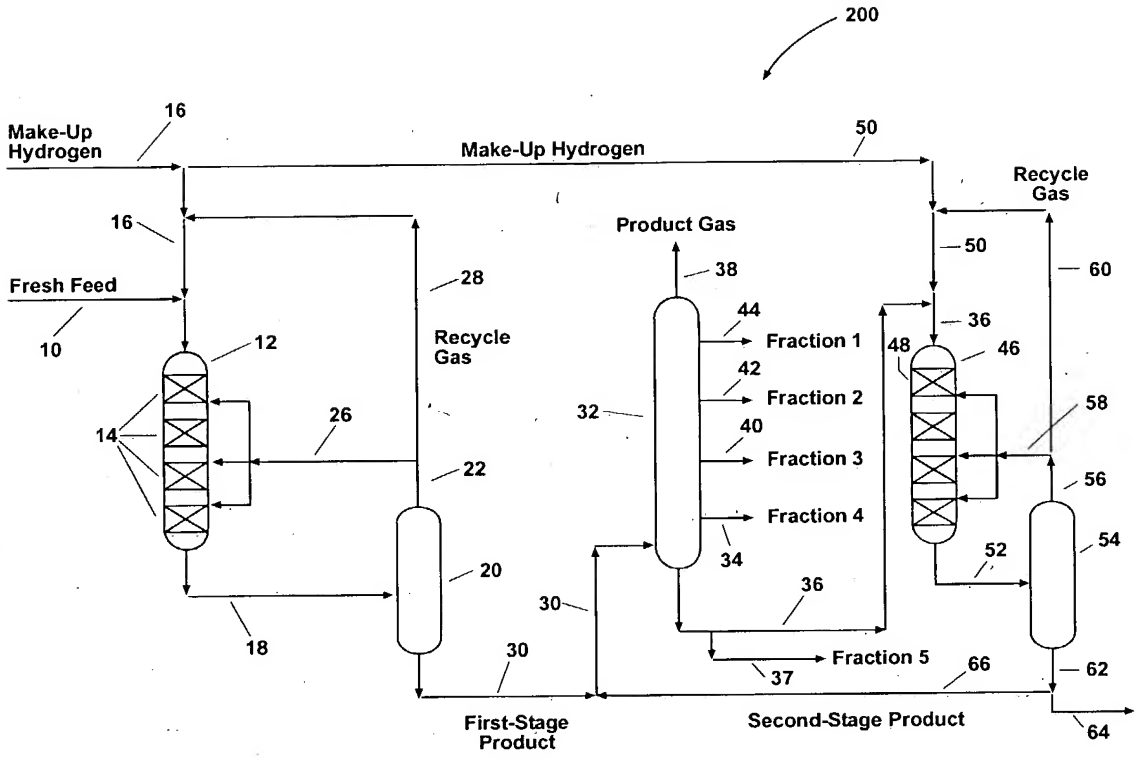

200
16
Make-Up Hydrogen
Make-Up Hydrogen
50
Recycle Gas
16
Product Gas
38
50
60
Fresh Feed
10
28
Recycle Gas
44
Fraction 1
36
12
48
46
42
Fraction 2
58
32
26
40
Fraction 3
14
22
56
Fraction 4
34
52
54
20
36
30
18
Fraction 5
66
62
30
37
First-Stage Product
Second-Stage Product
64

Figure 3

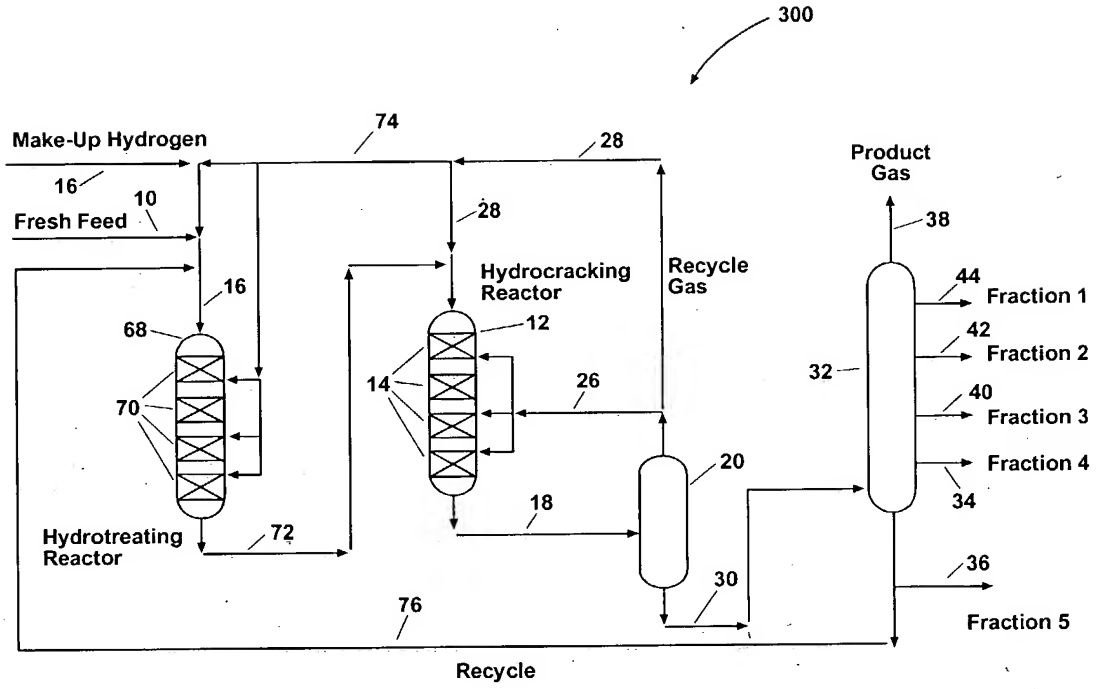

300
Make-Up Hydrogen
74
28
Product Gas
16
10
Fresh Feed
28
38
Hydrocracking Reactor
Recycle Gas
16
44
Fraction 1
68
12
42
Fraction 2
14
26
32
70
40
Fraction 3
20
Fraction 4
18
34
Hydrotreating Reactor
72
36
30
76
Fraction 5
Recycle

Figure 4

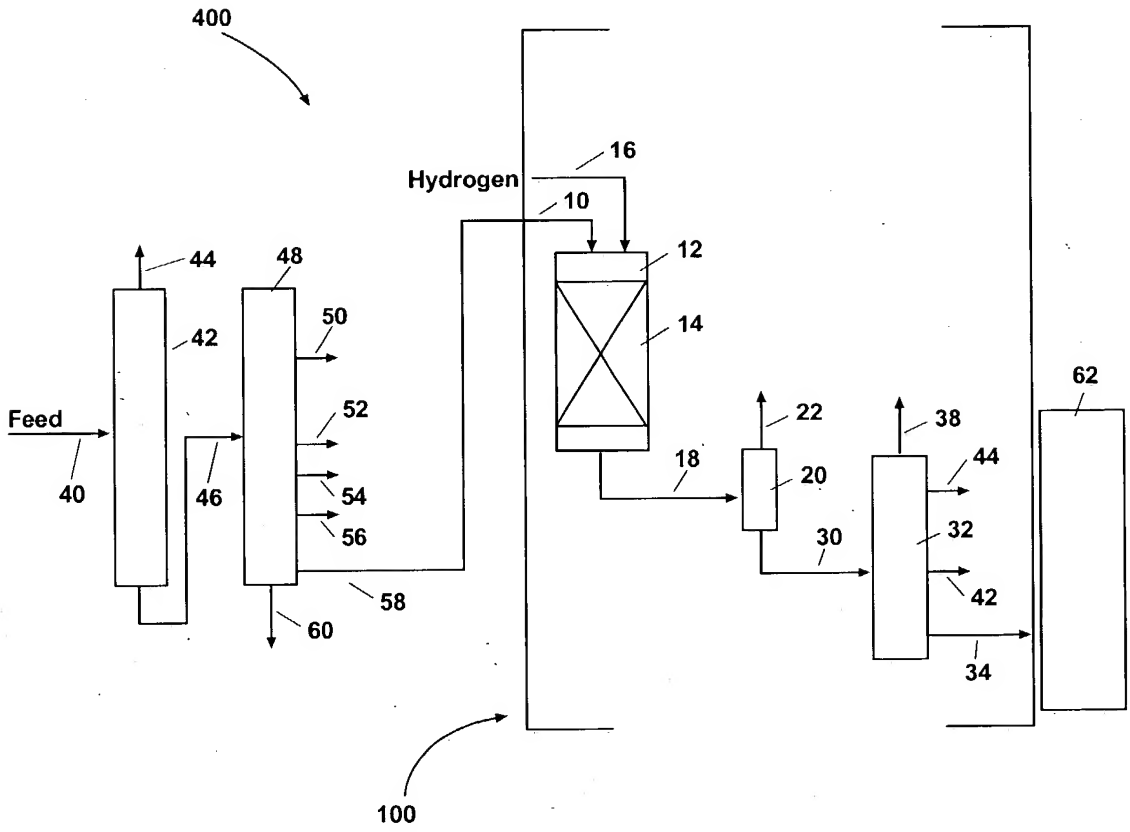

400
Hydrogen
16
10
12
14
44
48
50
42
52
Feed
40
46
54
56
58
60
18
22
20
30
38
44
32
42
34
62
100

Figure 5

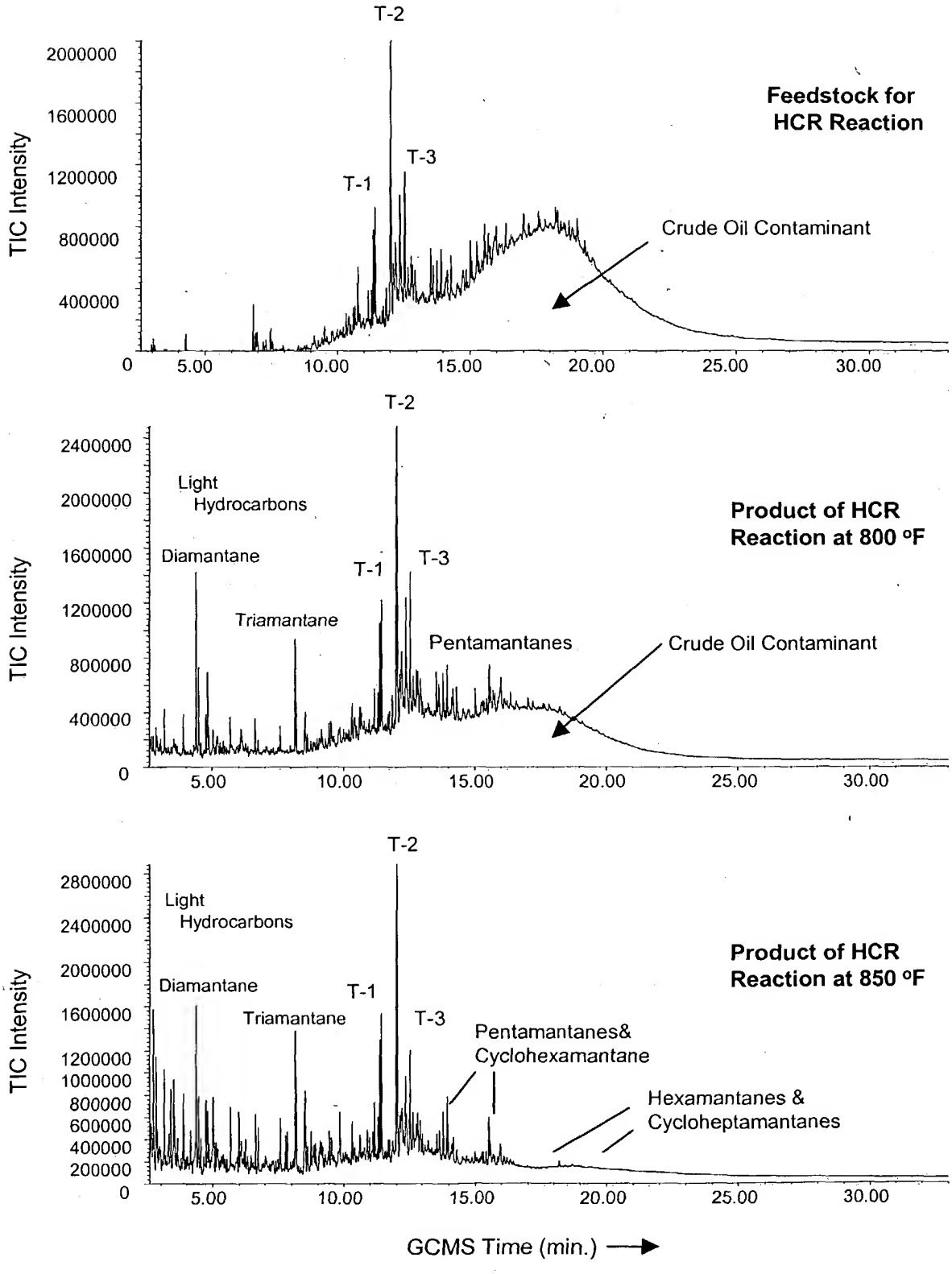

T-2
T-1
T-3
Feedstock for HCR Reaction
Crude Oil Contaminant
TIC Intensity
2000000
1600000
1200000
800000
400000
0
5.00
10.00
15.00
20.00
25.00
30.00
T-2
Light Hydrocarbons
Diamantane
Triamantane
T-1
T-3
Pentamantanes
Crude Oil Contaminant
Product of HCR Reaction at 800 °F
TIC Intensity
2400000
2000000
1600000
1200000
800000
400000
0
5.00
10.00
15.00
20.00
25.00
30.00
T-2
Light Hydrocarbons
Diamantane
Triamantane
T-1
T-3
Pentamantanes& Cyclohexamantane
Hexamantanes & Cycloheptamantanes
Product of HCR Reaction at 850 °F
TIC Intensity
2800000
2400000
2000000
1600000
1200000
1000000
800000
600000
400000
200000
0
5.00
10.00
15.00
20.00
25.00
30.00
GCMS Time (min.)

Figure 6

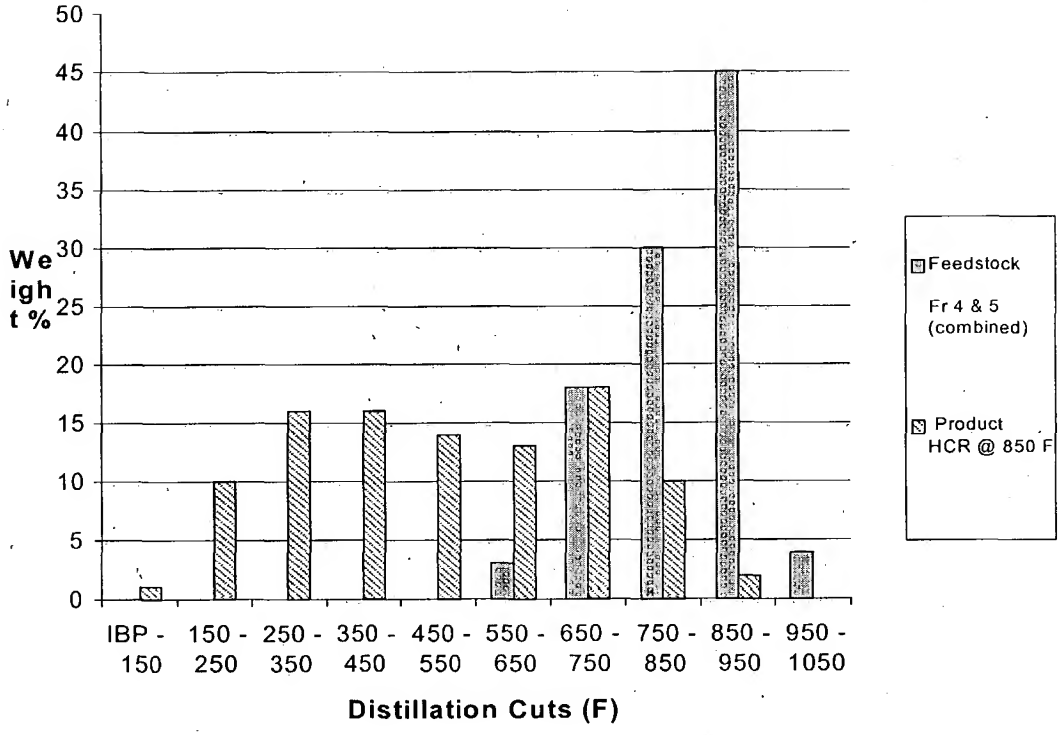

50
45
40
35
30
25
20
15
10
5
0
Weight %
IBP - 150
150 - 250
250 - 350
350 - 450
450 - 550
550 - 650
650 - 750
750 - 850
850 - 950
950 - 1050
Distillation Cuts (F)
Feedstock Fr 4 & 5 (combined)
Product HCR @ 850 F

Figure 7

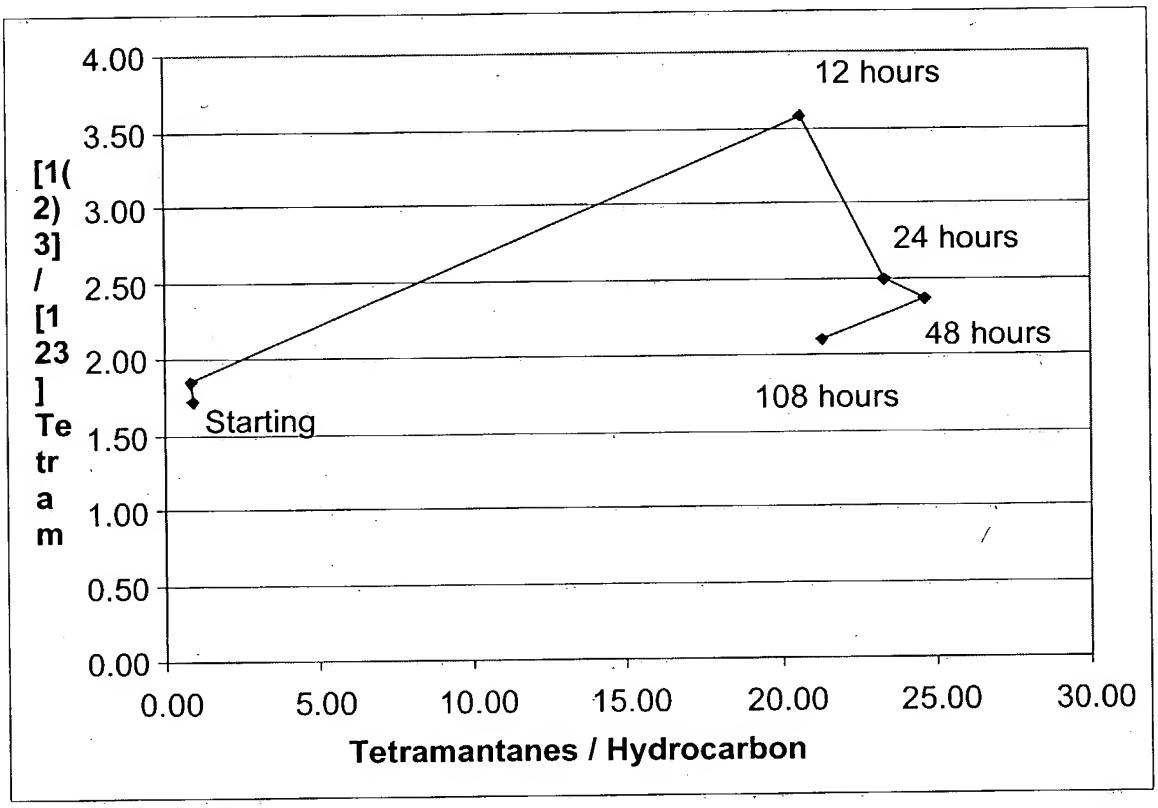

4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
[1(2)3]/[123]Tetram
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Tetramantanes / Hydrocarbon
12 hours
24 hours
48 hours
108 hours
Starting

Figure 8

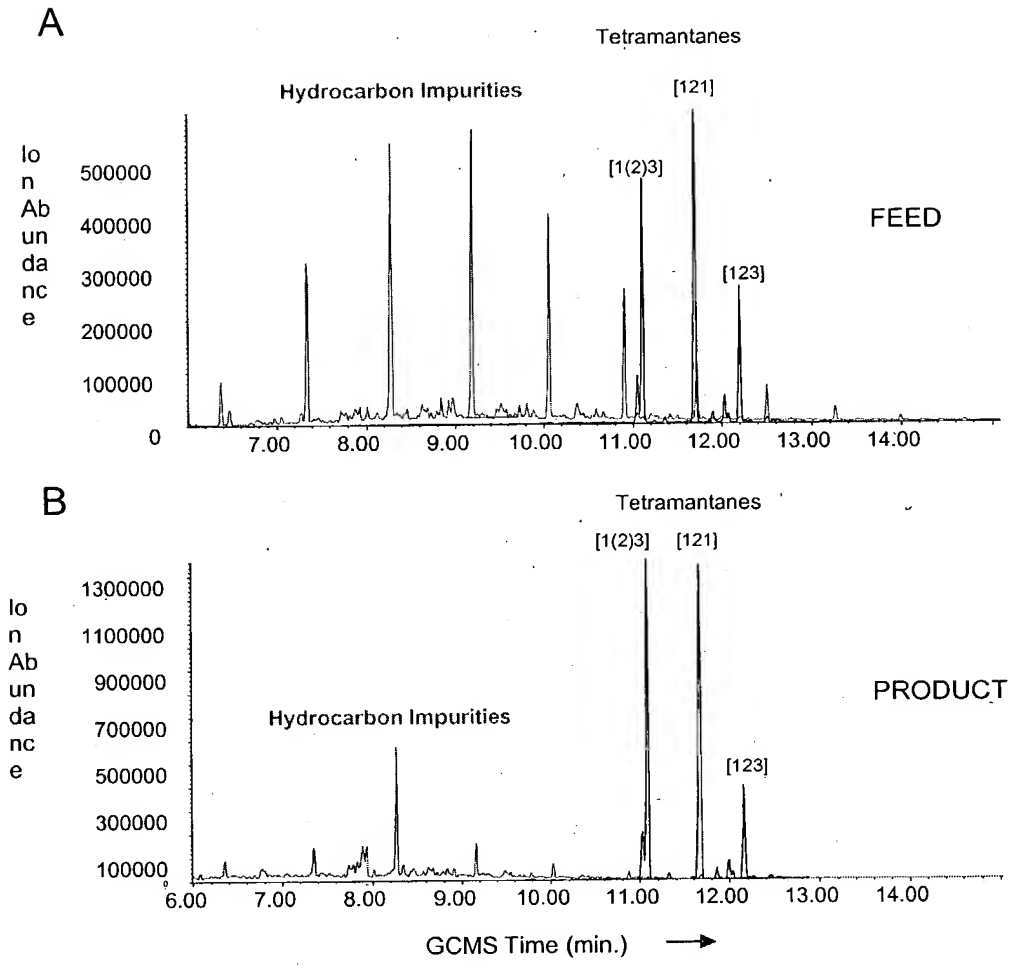
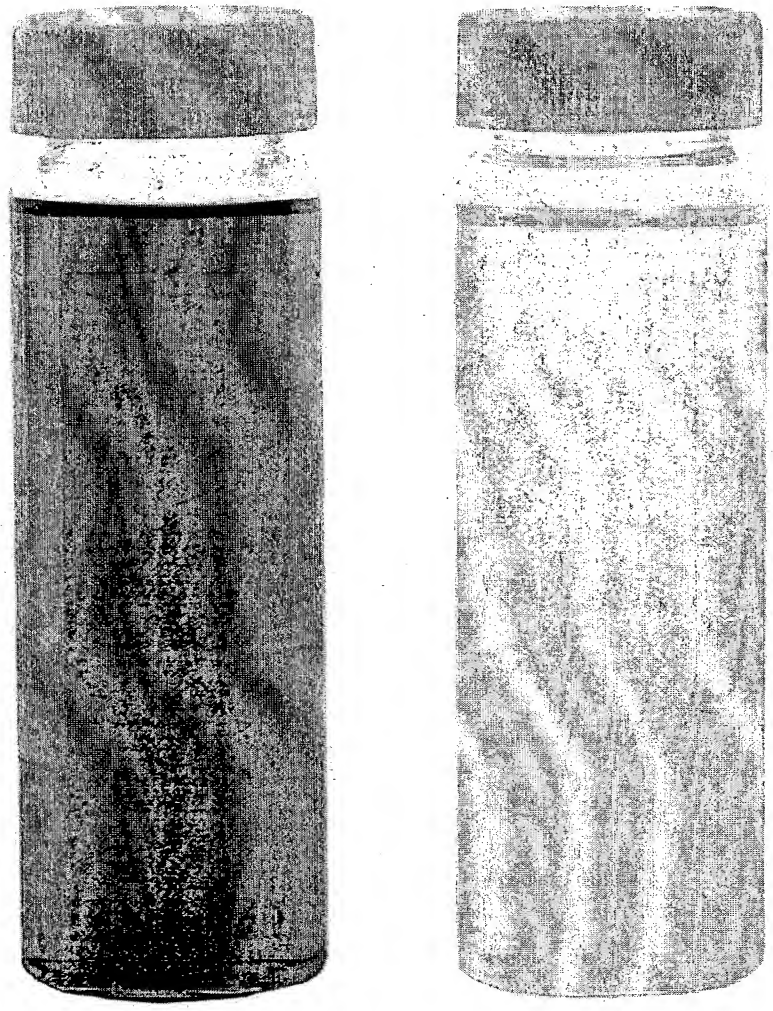
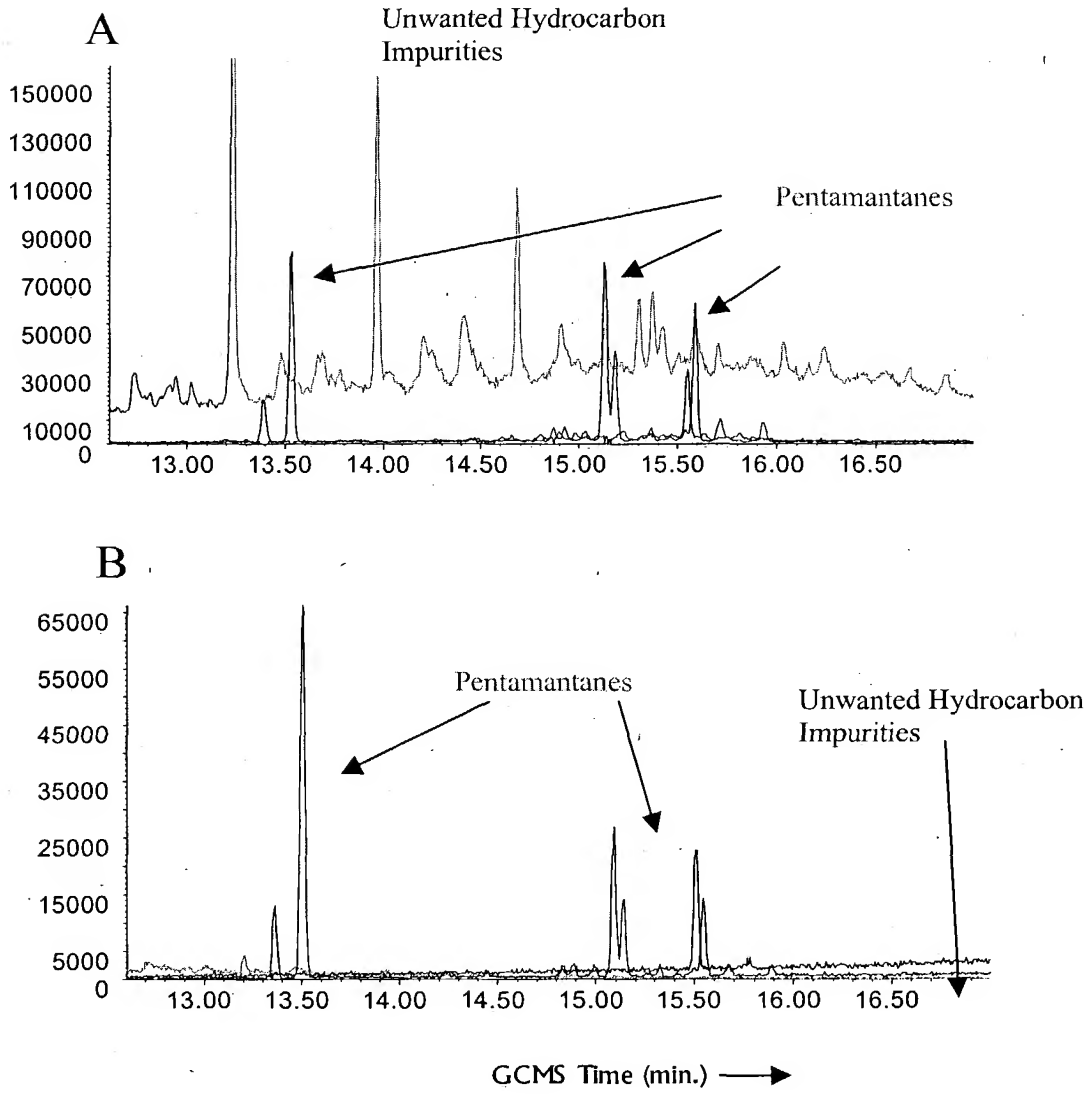

A
Tetramantanes
Hydrocarbon Impurities
[121]
[1(2)3]
[123]
FEED
Ion Abundance
500000
400000
300000
200000
100000
0
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
B
Tetramantanes
[1(2)3]
[121]
[123]
PRODUCT
Hydrocarbon Impurities
Ion Abundance
1300000
1100000
900000
700000
500000
300000
100000
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
GCMS Time (min.)

Figure 9



FEED PRODUCT

Figure 10


A
Unwanted Hydrocarbon Impurities
Pentamantanes
150000
130000
110000
90000
70000
50000
30000
10000
0
13.00
13.50
14.00
14.50
15.00
15.50
16.00
16.50
B
Pentamantanes
Unwanted Hydrocarbon Impurities
65000
55000
45000
35000
25000
15000
5000
0
13.00
13.50
14.00
14.50
15.00
15.50
16.00
16.50
GCMS Time (min.)